EXTENT OF CALVING
FOR THE BATHURST AND
AHIAK CARIBOU HERDS
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EXTENT OF CALVING FOR THE BATHURST AND AHIAK CARIBOU HERDS JUNE 2002

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ABSTRACT

In June 2002, we flew an aerial survey to map the extent of calving east and west of Bathurst Inlet, Nunavut. The distribution of calves was discontinuous across Bathurst Inlet which answered the question of whether we could distinguish between calving in the Ahiak and Bathurst caribou herds. The survey also revealed that the June 2002 distribution of the 18 cows fitted with satellite collars overlapped the distribution of cows with calves observed during the aerial survey 9–14 June 2002. This answers our second reason for doing the survey which was whether the satellite-collared cows are representative of the herd's calving distribution.

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INTRODUCTION

Characteristically, barren–ground caribou *Rangifer tarandus groenlandicus* annually return to calving grounds which are specific for each herd. Concerns about avoiding disturbing caribou on their calving grounds means that where caribou calve is important for land use planning and caribou management.

Those concerns in Canada came to the forefront in the 1970s during the Baker Lake court case over mining exploration which led to Caribou Protection Measures for the Beverly and Qamanirjuaq herds' calving and post–calving ranges (Mychasiw 1984). The court case also led to mapping calving grounds and research on caribou behaviour (Gunn 1984). During the subsequent years, considerable research efforts have focused on calving grounds relative to the impact of oil and gas development. Although the research was largely driven by concerns about oil and gas development, the research did increase understanding of calving ground ecology (Russell et al. 2002). In particular, we are starting to understand how features of calving grounds contribute to calf survival – a step toward describing the importance of calving grounds.

The first step in understanding the importance of calving grounds is to map their whereabouts. Calving grounds are traditional (succeeding generations of cows return to much the same part of their annual range for calving, Gunn and Miller 1986). However, fidelity to any particular geographic location for calving depends on the timescale over which it is measured. In any one year, the calving ground is the most predictably located seasonal range. Over several years, however, the cumulative

overlap of annual calving grounds over years decreases as the annual calving grounds directionally shift location. Satellite-collared cows from the Bathurst herd used 1.4% of the combined size of calving grounds 1996-2000 in all 5 years compared to 13% for 4 years, 18% for 3 years and 37% for 2 years (Gunn et al. 2001). Prior to the satellite collaring, periodic aerial surveys since the 1960s have revealed a gradual shift in the extent of calving from east to west of Bathurst Inlet (Sutherland and Gunn 1996) (Figure 1). Caribou calved west of Bathurst Inlet in the 1950s according to Inuit reports. This rotation over the longer timescale of several decades is also possible for the Beverly herd's calving grounds (Gunn and Sutherland 1997).

Figure 1. Distribution of caribou at or close to the peak of calving for the Bathurst caribou herd based on aerial surveys 1966 to 1996.

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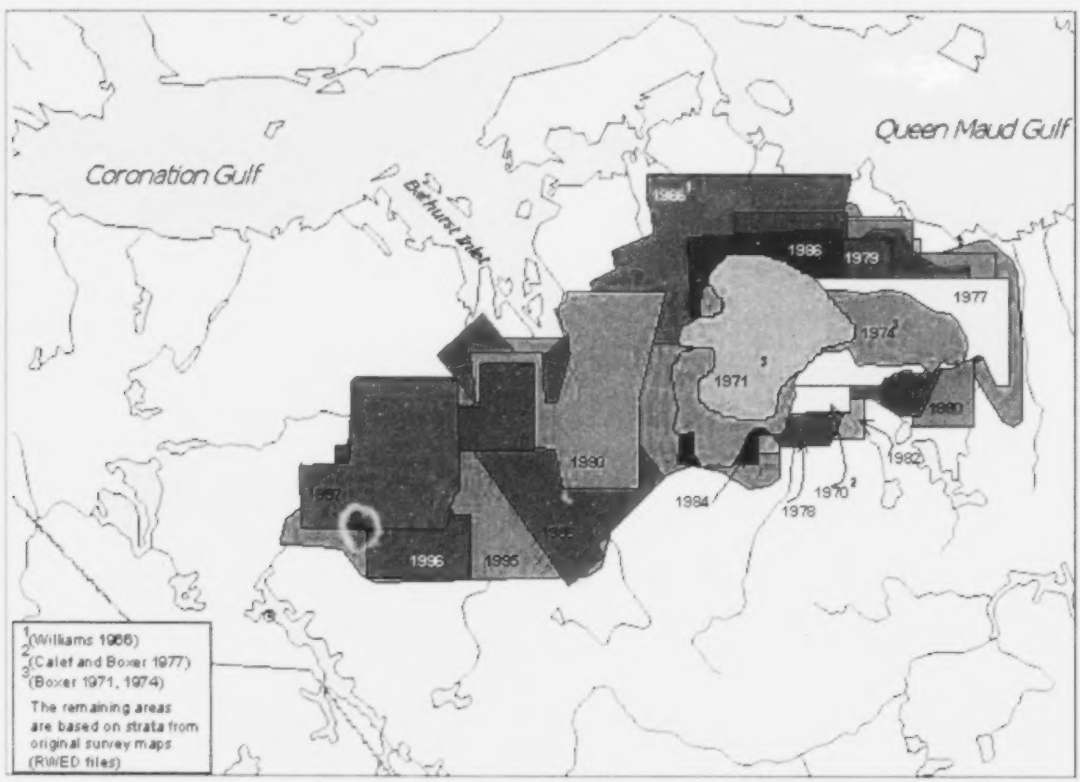
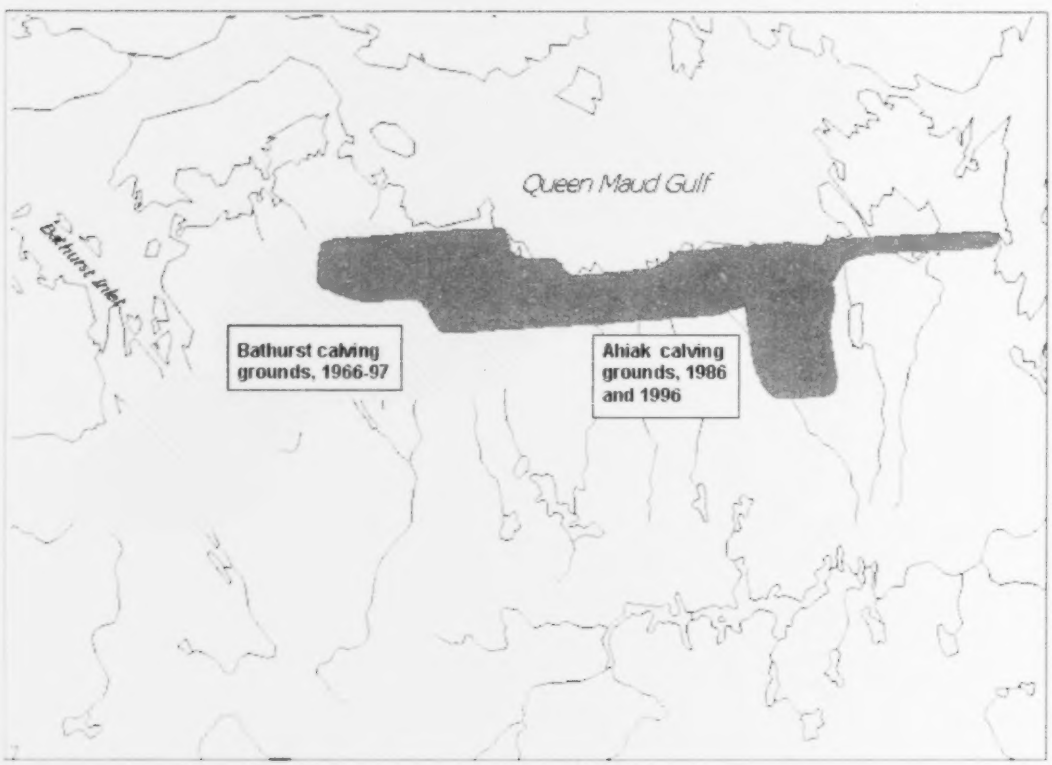


The shift in the extent of calving for the Bathurst caribou herd raises the relationship with the extent of calving for the neighbouring Ahiak herd. Although the Bathurst herd did not calve east of Bathurst Inlet during the 1990s, aerial surveys in June 1986 and 1996 revealed that the Ahiak (Queen Maud Gulf) herd calved east of Bathurst Inlet. The Ahiak herd's calving distribution overlapped with the previously used (traditional) extent of calving for the Bathurst herd (Figure 2).

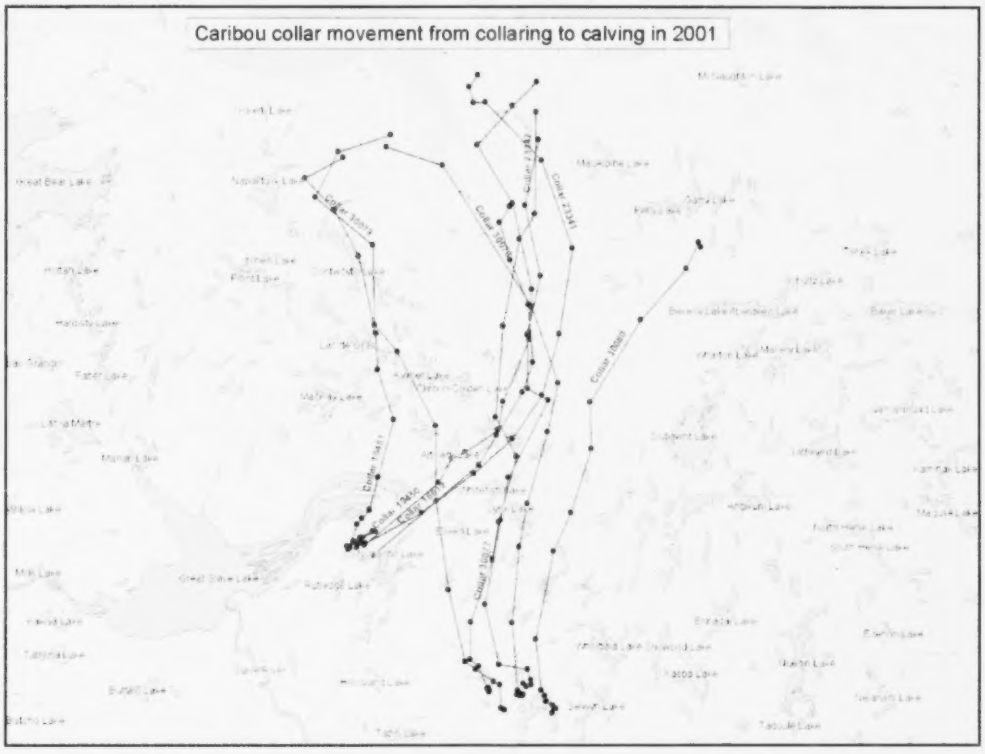
Figure 2. Distribution of caribou at or close to the peak of calving for the Ahaik caribou herd 1986 and 1996.



Relatively little has been reported about the Ahiak herd but the justification for identifying it as a separate herd from the Bathurst herd (Gunn et al. in prep.) was based on 1996–98 satellite telemetry and that caribou from the Ahiak herd are genetically distinct from both the Beverly and Bathurst herds based on nuclear DNA (K. Zittslau unpubl. data). The 1996–98 satellite telemetry revealed that the Ahiak, Bathurst and Beverly herds overlap on their winter ranges. The Ahiak herd switched from wintering on the barrens to wintering within the taiga as far south as Rennie Lake in 1997/98 (Gunn et al. 2000) which is also within the winter ranges for both the Beverly and Bathurst herds.

Further evidence for the Ahiak herd overlapping the known winter ranges for the Beverly herd and the Bathurst herd became apparent after fitting satellite collars on caribou southeast of Great Slave Lake in April 2001 (Gunn et al. In prep.). We had collared nine caribou in two geographic areas in March 2001 where the cows collared in 1998 were wintering along the NWT/Saskatchewan border and southwest of Lutsel K'e (Figure 3). Five of the nine cows migrated east of Bathurst Inlet for calving 2001. Three of the nine 2001 collared cows migrated northwest and, in June 2001, were with the 1998 collared cows west of Bathurst Inlet which had calved west of the Inlet in 1998-2000 (Figure 3). The ninth cow went to the Beverly calving grounds.

Figure 3. Collaring locations and spring migration routes for cows fitted with satellite collars March – June 2001, NWT and Nunavut.



The two alternative explanations for the cows collared in April 2001 as being either west or east of Bathurst Inlet during calving, are that both Ahiak and Bathurst cows were collared in April 2001 or that the Bathurst herd had resumed calving east of Bathurst Inlet. The grouping of the collared cows east and west of Bathurst Inlet during calving also held for the 2001 rut (Figure 4), which suggests that cows collared in April 2001 were from two herds.

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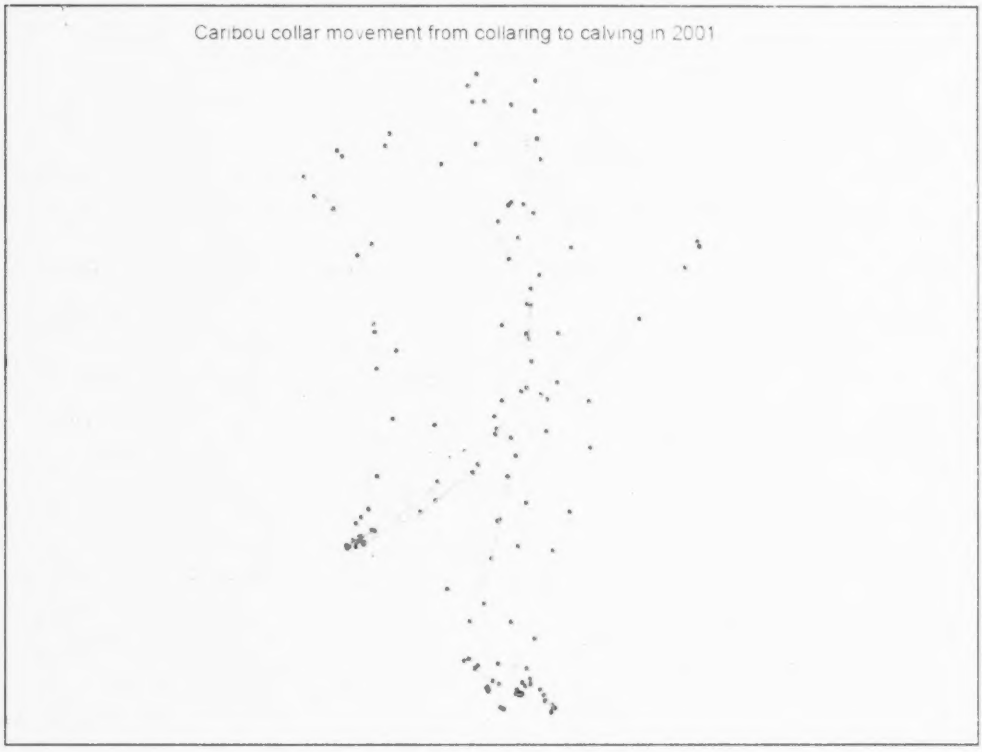

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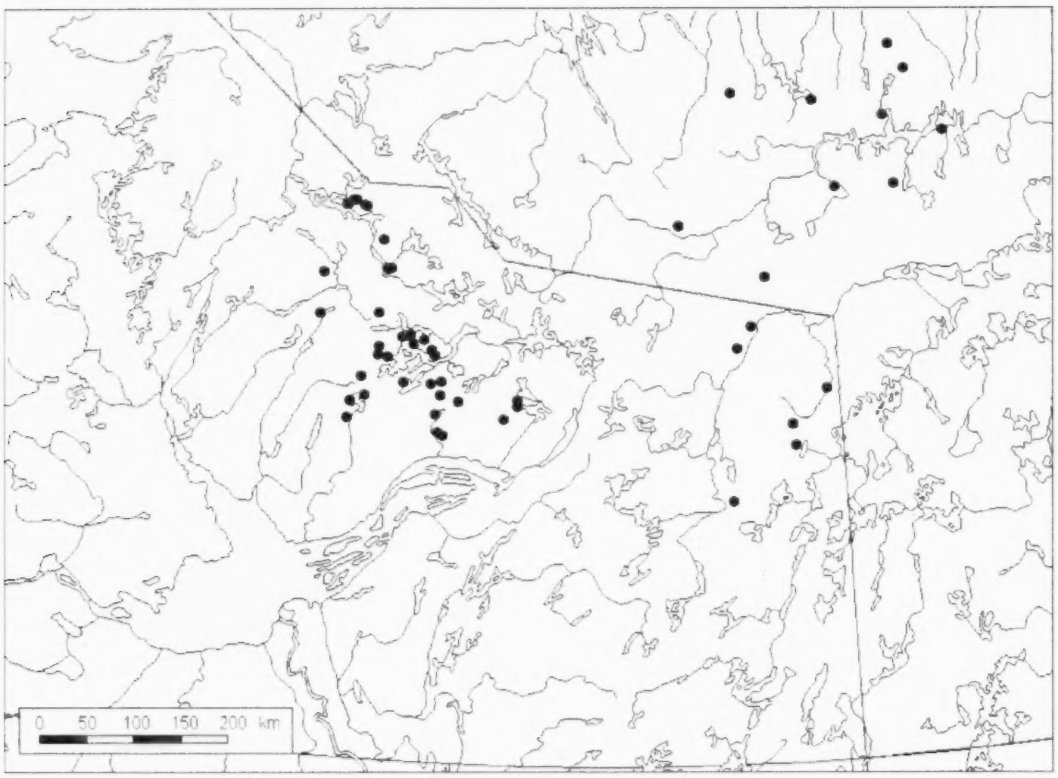
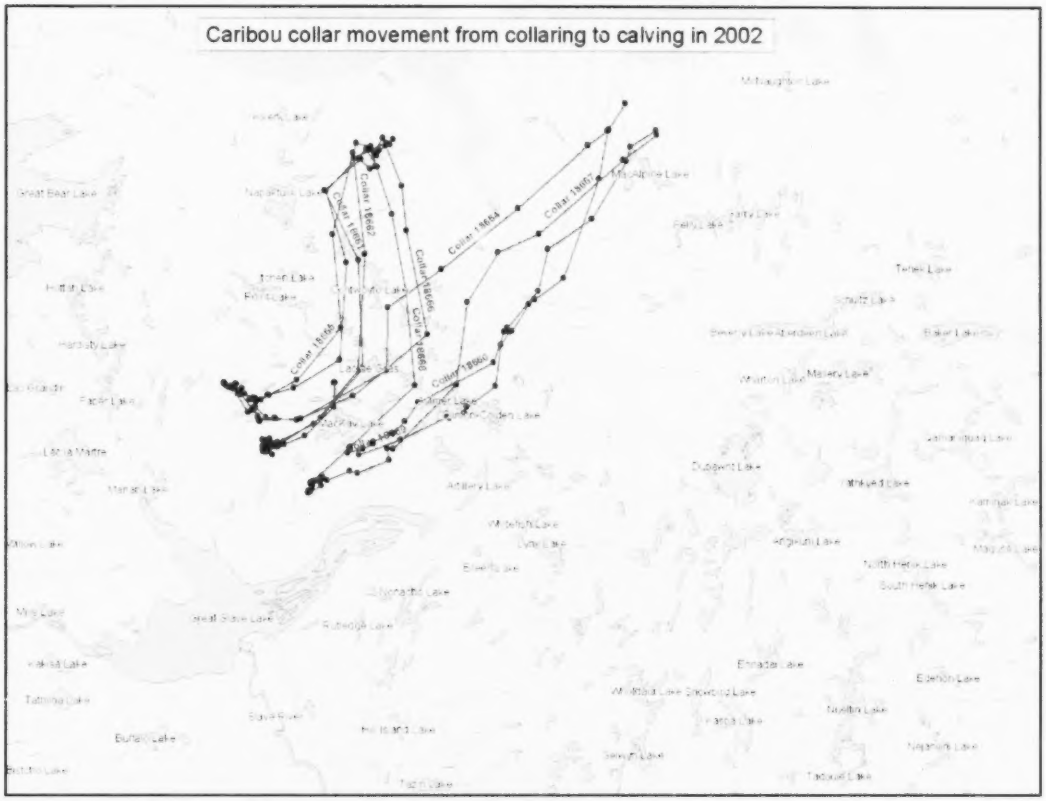
Figure 4. Distribution of satellite–collared caribou cows, October 2001.



The overlapping wintering distribution in 2000–01 southeast of Great Slave Lake between the Ahiak and Bathurst herds meant that we had fewer satellite collars on the Bathurst herd for monitoring caribou distribution relative to mining and other activities. Thus in March 2002, we collared a further 11 caribou cows northwest of Great Slave Lake (Figure 5). However, by mid-May, those caribou were splitting into cows heading west and east of Bathurst Inlet suggesting again that the winter ranges of two herds had again overlapped during the 2001–02 winter.

Figure 5. Collaring locations and spring migration routes for cows fitted with satellite collars March – June 2002.



The gradual shift in the extent of calving over a number of years has implications for land–use planning. A first step is to reduce any confusion following from differing definitions of calving grounds. Russell et al. (2002) report a recent consensus by caribou biologists over defining calving grounds – an area occupied by parturient caribou from birth through the initiation of foraging by calves (calves becomes foragers at about 3 weeks after birth). This definition is more securely tied to the ecology of calving as it recognizes the time when calves are most sensitive to

the maternal and environmental conditions that affect their growth and when they are most vulnerable to predation.

Satellite collars provide a series of locations which helps to map the extent of calving (the area used from the peak of calving and the following 3 weeks). But the use of satellite telemetry raises the question of how representative the collared cows are for the distribution of the herd's calving cows. Typically, only a few 10–20 cows are fitted with satellite collars at any one time.

The two questions then to be answered from the aerial survey of calving distribution described in this report are firstly, that in planning for a census of the Bathurst herd, we need to know if we can distinguish between the calving distribution of the Bathurst and Ahiak herds. Distinguishing between the calving distributions will depend on whether distribution of calving cows east and west of Bathurst Inlet is continuous or discontinuous.

The second question is whether the satellite-collared cows are representative of the herd's calving distribution. The criteria will be firstly, if the distribution of the collared cows is within the distribution of cows with calves observed during the aerial survey during the same period in early June. The second criterion is whether the densities within 10 km of the collared cows are within range of densities measured on the calving grounds.

METHODS

We used a systematic aerial reconnaissance to determine whether the distribution of cows and calves was continuous across the Bathurst Inlet area. The survey area was divided into three blocks with the west and east ones centred on the 1996 calving distribution (1996 was the most recent aerial survey). The centre block covering Bathurst Inlet is the area that divided the 1996 Bathurst and Ahiak calving distribution.

We carried out a systematic, fixed-strip (0.5 km either side of the transect line) aerial survey, with planned uniform coverage of *ca.* 5% for the survey. Survey altitude was 150 m above ground level and airspeed was 160 km • h^{-1}. We classified caribou as antlered cows, calves, antlerless caribou, juveniles and bulls based on body size and whether antlers were either light-coloured and polished or in dark velvet. We estimated the size of larger groups by counting in blocks of 10s, 50s and 100s.

We listened for radio-signals from the VHF transmitters on the satellite collars by flying at 1 000 to 2 500 m agl in the vicinity of the most recent satellite location for each collared cow. On receiving a signal we descended to 150 m agl to estimate caribou density along four 10 km transects radiating out at 90^{O} to each other and centered on the location of each collared cow.

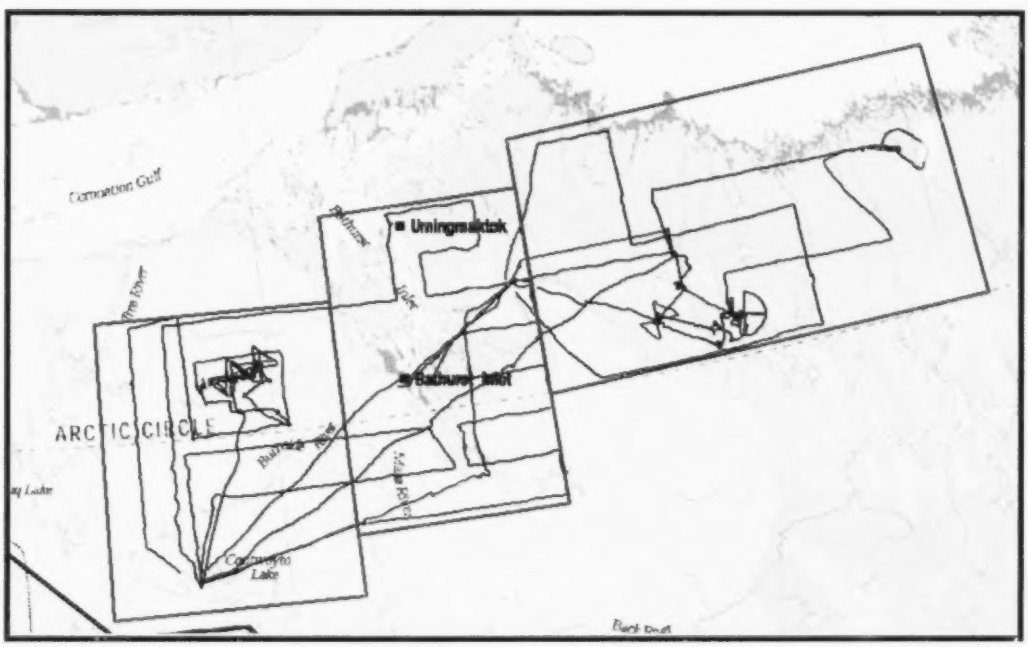
Using the locations at 5 daily intervals for the satellite–collared cows, we measured the daily distance travelled. We used ANOVA and t–tests to examine for differences between the rates of movements. The calving area probability polygons were calculated using Kernel Home Range of Animal Movement Analysis (ArcView

Extension version 2.0; USGS-BRD, Alaska Science Center, Biological Science Office, Glacier Bay Field Station, Philip N. Hooge). This tool calculates a fixed kernel home range utilization distribution and maps probability polygons. The interpolated raster of calving group distribution was generated from ArcGIS Spatial Analyst 8.2 using Inverse Distance Weighting with default parameters. Excluding group size of 0-15 from display was arbitrary and done to illustrate concentration areas.

RESULTS

We flew 40 hours based out of Echo Bay's Lupin mine on Contwoyto Lake between 9 and 12 June 2002 (Figure 6). Coverage was 8% across the western block (2267 km^2 ; 30 400 km^2); 7% for the central block (1775 km^2 ; 20 700 km^2) and 5% for the eastern block (2179 km^2 ; 46 760 km^2). We counted 10 667 caribou on transect and 673 caribou off transect. Of the caribou on transect, we classified 42%: 33% cows with calves, 19% calves, 14% antlered cows, 15% antlerless caribou, 5% juveniles and 4% bulls (Figures 7 – 9).

Figure 6. Flightlines and the western, central and eastern survey blocks, west and east of Bathurst Inlet, Nunavut, 9–12 June 2002.



Two-thirds of the caribou were in the western survey block where densities were highest (310 caribou/100km^2). The eastern survey block had 25% of the total caribou seen the density was 130 caribou/100km^2. Only 7% of caribou counted were in the central survey block (50 caribou/100km^2).

Calving distribution: The distribution of calves across Bathurst Inlet was discontinuous (Table 1, Figure 7). Caribou cows with calves were clumped within the western and eastern survey blocks. We counted 1687 cows with 1015 calves in the western survey block, which was 38% of the caribou in that block. The area (7440 km^2) enclosing all cows with calves was centred on the Hood River (24% of the survey block). In the eastern survey block, we saw 400 cows with 169 calves, which was 20% of the caribou seen. The cows and calves were east of the Ellice River and dispersed across a relatively large area (16 460 km^2; 35% of the survey block). In the central survey block, we only saw a single calf in a group of 12 cows at the southern end of Bathurst Inlet.

Figure 7. Extent of calving based on caribou calves observed during the aerial survey 9–12 June 2002 and routes travelled by satellite-collared cows 4–15 June 2002 west and east of Bathurst Inlet, Nunavut.

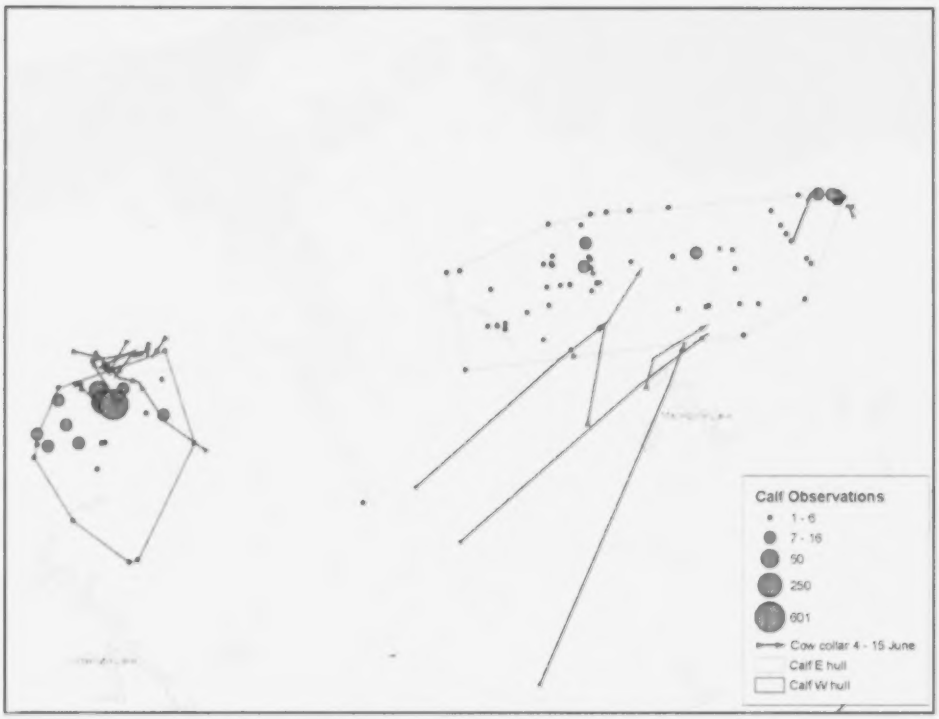


Table 1. Sex and age composition of caribou in three survey blocks counted during an aerial survey, 9-12 June, 2002, Bathurst Inlet area, Nunavut.

Survey Block	Cows	Calves	Antlered cows	Antlerless cows	Un-classified Caribou	Juveniles	Bulls	Total
Eastern	400	169	697	1021	292	174	106	2823
Central	12	1	96	265	290	62	70	796
Western	1687	1015	98	274	3903	61	39	7048
	2099	1185	903	1559	4484	295	241	10 667

The proportion of antlered cows was highest in the eastern survey block (25%) compared to 2% in the western block and 12% in the central block (Figure 8, Table 1). The percentage of antlerless cows was also highest in the eastern survey block but that may be obscured by the high proportion of unclassified caribou in the western block (unclassified included cows and juveniles with inconspicuous new antler growth as well as cows with recently shed antlers). The proportion of yearlings and bulls was lowest in the western survey block (<1%) compared to 8% yearlings and 9% bulls in the central block and 6% yearlings and 4% bulls in the eastern block.

Figure 8. Observations of antlered caribou cows west and east of Bathurst Inlet, Nunavut, 9–12 June 2002.

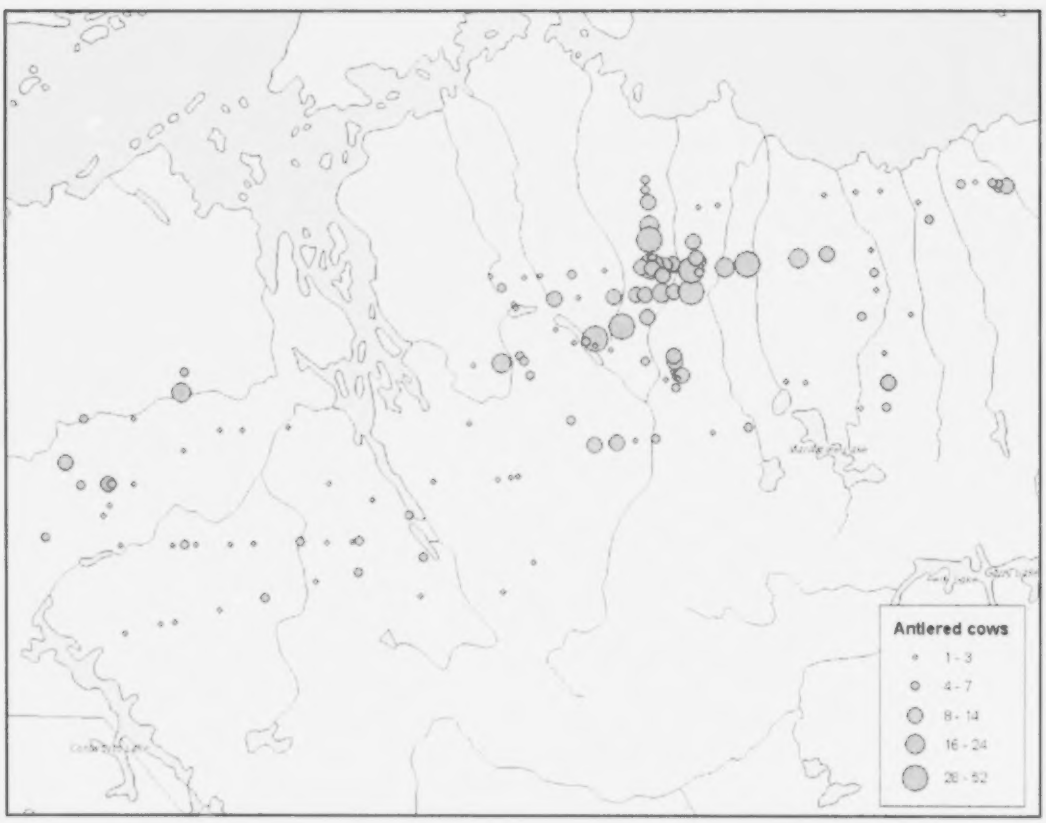
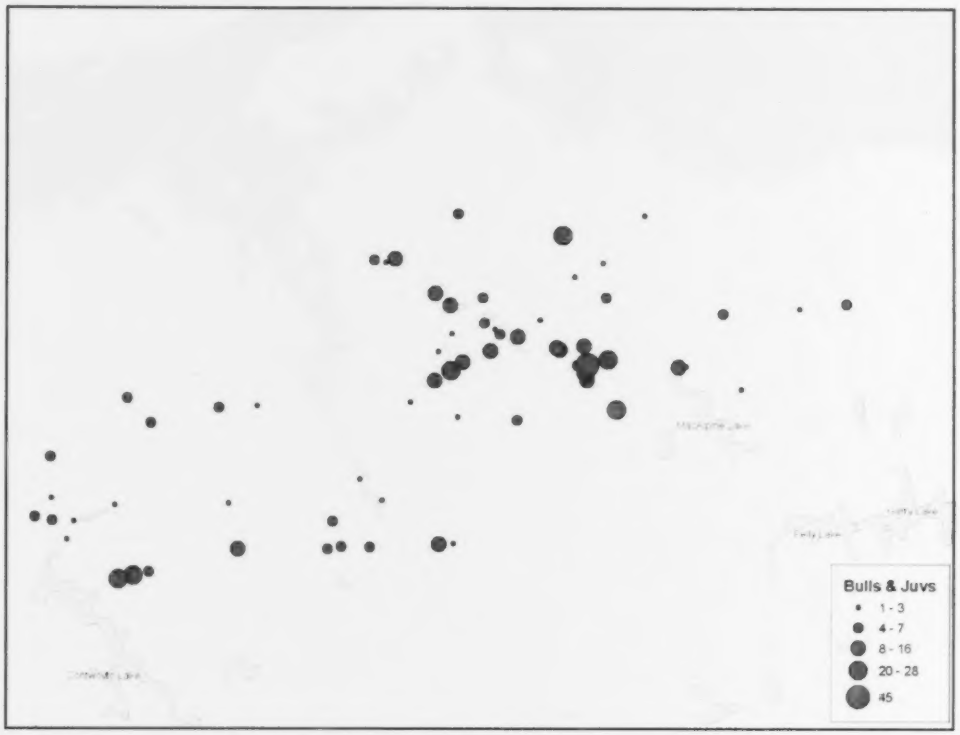


Figure 9. Observations of caribou bulls and juveniles west and east of Bathurst Inlet, Nunavut, 9–12 June 2002.



Representativeness of satellite-collared cows: The June 2002 distribution of the 18 cows fitted with satellite collars overlapped the distribution of cows with calves observed during the aerial survey 9–14 June 2002 (Figures 10 and 11). West of Bathurst Inlet, 10 of the 11 collared cows were north of the Hood River by 4 June 2002 and only cow 79 did not cross the Hood River. The movements for 10 of the 11 collared cows between 4-15 June took them to within the polygon enclosing the distribution of cows with calves based on the aerial survey 9–11 June. The 11th cow, Cow 662, had moved to 5 km north of the polygon enclosing the distribution of cows with calves by 14 June.

Figure 10. Movements of satellite–collared cows June 4 to 15 relative to calves observed during the aerial survey west of Bathurst Inlet, Nunavut, June 2002.

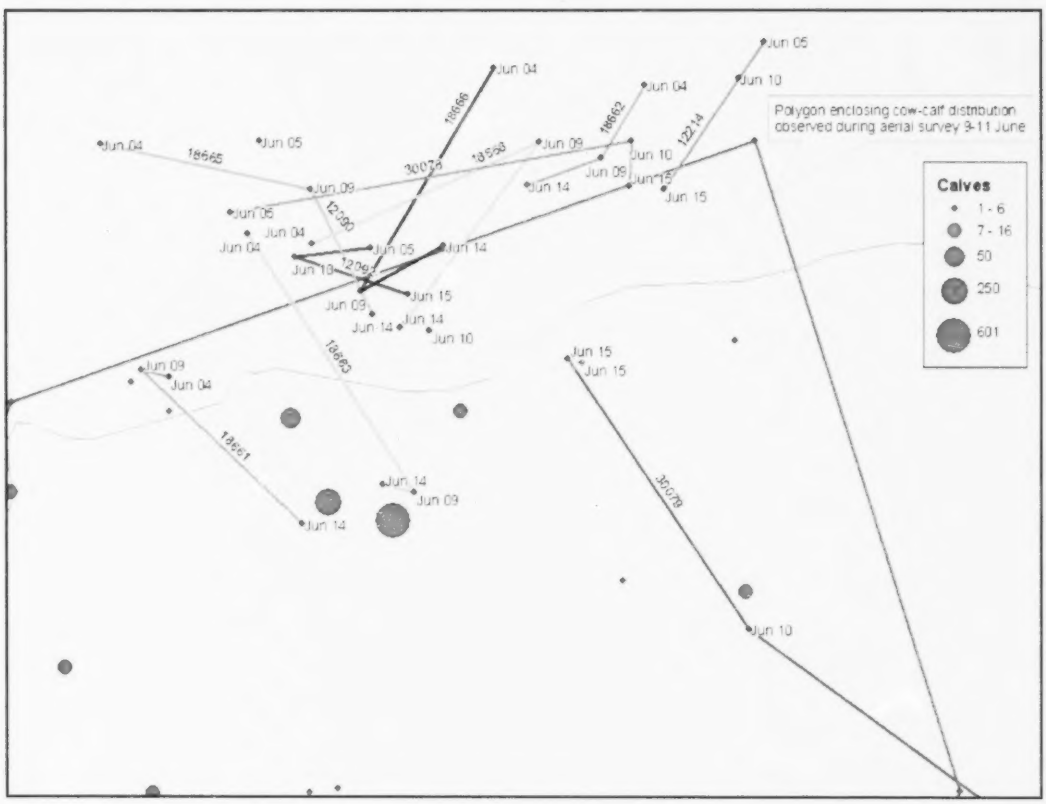
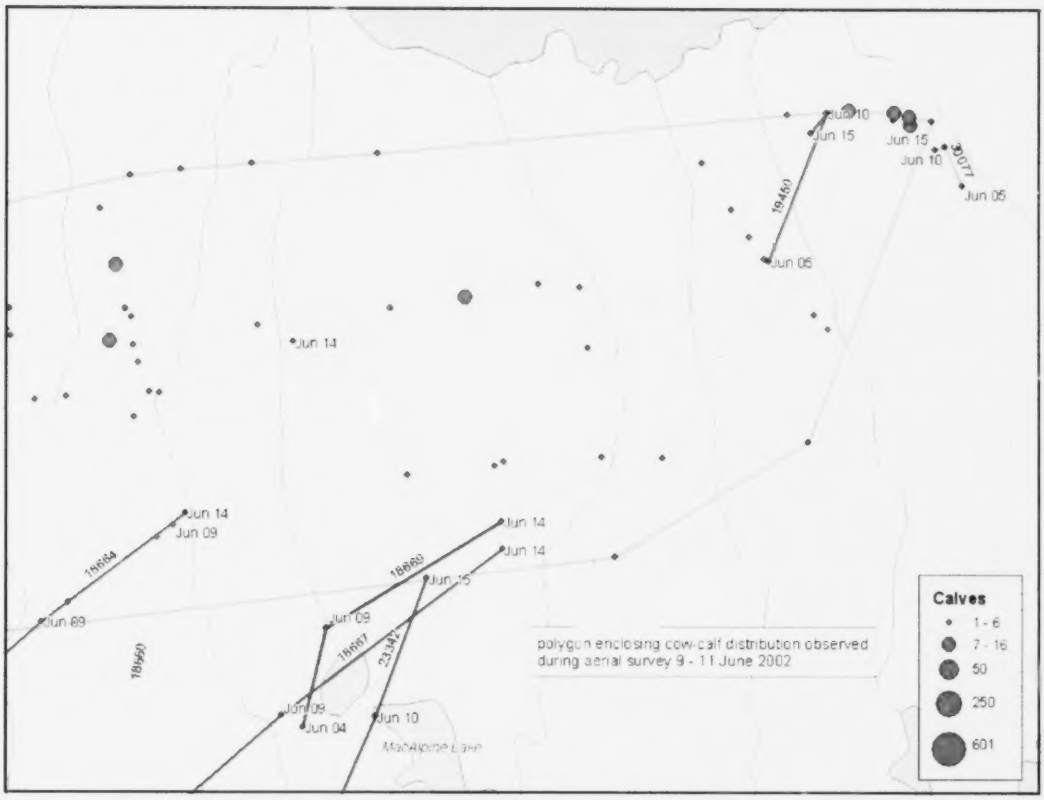


Figure 11. Locations of satellite–collared cows relative to calves observed during the aerial survey east of Bathurst Inlet, Nunavut, June 2002.



East of Bathurst Inlet, five of the 6 collared cows were within the polygon enclosing the distribution of cows with calves in the eastern survey block by 14 June (Figure 11). The seventh cow (Cow 77) was within 1 km of the eastern boundary.

Radio-tracking was mostly unsuccessful as we were not receiving signals: we located 5 collared cows and heard but could not locate two other collars – we were reluctant to descend to lower altitudes where there were many caribou. We located two of the seven collared caribou in the eastern survey block. Cow 69 was an antlered cow with a mean density 175 +/- 83 SE caribou/100 km^2 within a 10 km radius. Cow

Figure 11. Locations of satellite-collared cows relative to calves observed during the aerial survey east of Bathurst Inlet, Nunavut, June 2002.

East of Bathurst Inlet, five of the 6 collared cows were within the polygon enclosing the distribution of cows with calves in the eastern survey block by 14 June (Figure 11). The seventh cow (Cow 77) was within 1 km of the eastern boundary.

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64 was also an antlered cow and in a group with a newborn calf. The mean density was 750 +/-54 SE caribou/100 km^2 of cow 64. Those densities exceeded the densities for the entire eastern survey block. The sex and age composition of the 371 cows counted during the sampling of density in the vicinity of the two collared cows had a similar proportion of antlerless cows to the overall eastern survey block. The percentage of cows and calves and antlered cows was lower and the proportion of bulls, juveniles and unclassified was higher (Table 2).

In the western survey block, we located four of 11 collars but given the high densities and large groups of cows and calves, we flew the 10 km transects at 230 m agl and did not attempt to classify the caribou or count calves. The mean density within a 10 km radius around the four collared cows was an order of magnitude higher than the mean density for the western survey block. Given that the remaining collars were within the area with calving caribou, we did not continue the effort to determine densities associated with each collared cow.

Table 2. Numbers, sex and age composition of caribou along four 10 km radii centred on radio-tracked cows, 9-12 June 2002, Bathurst Inlet area, Nunavut.

	Cows	Calves	Antlered cows	Antlerless cows	Un-classified	Juveniles	Bulls	Total
Cow 69 N	0	0	1	2	1	3	6	13
S	0	0	0	0	0	0	0	0
E	0	0	1	8	5	3	0	17
W	0	0	0	17	23	0	0	40
Cow 64 N	2	1	29	32	0	0	0	78
S	0	0	6	32	12	24	13	87
E	0	0	8	23	9	16	5	61
W	0	0	1	11	57	4	2	75
Cow 65 N	100	-[1]	-[1]	-[1]	-[1]	-[1]	0	180
S	3100	-[1]	-[1]	-[1]	-[1]	-[1]	0	3100
E	7420	-[1]	-[1]	-[1]	-[1]	-[1]	0	7420
W	110	-[1]	-[1]	-[1]	-[1]	-[1]	0	110
Cow 66 N	1315	-[1]	-[1]	-[1]	-[1]	-[1]	0	1315
S	930	-[1]	-[1]	-[1]	-[1]	-[1]	0	930
E	240	-[1]	-[1]	-[1]	-[1]	-[1]	0	240
W	8630	-[1]	-[1]	-[1]	-[1]	-[1]	0	8630
Cow 62 N	1100	-[1]	-[1]	-[1]	-[1]	-[1]	0	1100
S	330	-[1]	-[1]	-[1]	-[1]	-[1]	0	330
E	250	-[1]	-[1]	-[1]	-[1]	-[1]	0	250
W	380	-[1]	-[1]	-[1]	-[1]	-[1]	0	380
Cow 68 N	280	-[1]	-[1]	-[1]	-[1]	-[1]	0	280
S	1260	-[1]	-[1]	-[1]	-[1]	-[1]	0	1260
E	940	-[1]	-[1]	-[1]	-[1]	-[1]	0	940
W	1150	-[1]	-[1]	-[1]	-[1]	-[1]	0	1150

[1] Calves and other caribou were present but not classified to minimize disturbance.

The total distance traveled by the satellite–collared cows (measured as straight-line distances between consecutive locations at 5–daily intervals) during spring migration varied (Table 3, Appendix A) as their wintering locations differed. We did not find either a significant difference between the individual rates of movement from April 15 to June 15 2002 (P=0.569) for the satellite–collared caribou from the Bathurst or Ahiak herd (P=0.946). The changes in the rates of daily movements between the two herds was not great enough to be possibly due to chance (T=-0.272, 22 degrees of freedom, P=0.789).

Table 3. Total distance (km) traveled during spring migration for satellite–collared caribou from the Bathurst and Ahiak herds.

Caribou No.	Bathurst herd distance traveled km	Caribou No.	Ahiak herd distance traveled km
90	510.16	450	563.76
92	477.12	42	737.67
14	467.82	77	315.9
78	552.83	60	535.22
79	529.06	64	649.36
61	614.33	67	648.45
62	480.16	69	452.36
63	493.99		
65	451.68		
66	431.98		
68	538.03		
76	565.56		
Mean	509.393		557.531
Standard Error	15.187		53.259

DISCUSSION

Adjacent but geographically separate calving grounds

The Bathurst and Ahiak annual calving grounds were geographically separate in June 2002 based on the distribution of calves between 9 and 12 June. We did not see calves in the survey block centred on Bathurst Inlet except one calf at the south end of Bathurst Inlet. However, some antlered cows (presumably cows that had calved and lost their calves within a day or two or cows that had yet to calve) were dispersed across the southern two thirds of the central survey block.

We suggest that those antlered cows (11% of caribou seen in the central block) were the 'tail end' of the spring migration. The antlered cows west of Bathurst Inlet were likely cows from the Bathurst herd and not from the Ahiak herd. Both in 2001 and 2002, collared cows followed a pre-calving migration route east of Contwoyto Lake and entered the calving ground from the southeast. In June 2002, cow 79 moved 85 km between 5 and 15 June travelling northwest into the calving ground. The cow's rapid movement and direction of travel suggests that the antlered cows southeast of the calving ground (west of Bathurst Inlet) could be moving toward the Bathurst calving ground.

The bulls and most juveniles were south of the antlered cows west and east of Bathurst Inlet (Figure 9). Pregnant cows migrate earlier than bulls and juveniles, which suggests that the distribution of bulls across the southwest edge of the Ahiak calving ground indicates the most all Ahiak cows had reached their calving ground. We saw relatively few bulls west of Bathurst Inlet.

Timing of peak calving differed between the Bathurst and Ahiak herds in 2002. Cows and calves west of Bathurst Inlet were aggregating into large groups of thousands by 11 June, suggesting that calving may have peaked 8-10 June. To minimize disturbance, we did not attempt to count all cows and calves in the large aggregations but the percentage of cows with calves was at least 60% and the percentage of cows with calves that were single cow calf pairs was 2%. In contrast, on the Ahiak calving ground group size was smaller with a higher proportion of single cow calf pairs (16%), a higher proportion of antlered cows and the percentage of cows with calves was 42%. In 1996, we also recorded that calving in the Ahiak herd was a few days later than the Bathurst herd (Gunn et al. 2000).

Two collared cows from the Ahiak herd in early June were within 10 km of the boundary of the Ahiak calving ground boundary mapped in 1996. Three cows were 25 km southwest of the 1996 calving ground which may suggest the calving ground has continued to spread west (as occurred between 1986 and 1996) or that the late 2001 spring delayed the arrival of the cows.

Mapping the extent of annual calving

Describing the location of calving grounds also depends on how calving grounds are defined. Previous maps of calving grounds for the Bathurst and Ahiak herds were based on aerial surveys close to or within days of the peak of calving (Sutherland and Gunn 1996, Gunn et al. 2000). However, Russell et al (2002) recommended mapping the extent of calving as the area used up until 3 weeks past the peak of calving. The median peak of calving for the Bathurst herd is 5 – 9 June

but has been recorded as late as 11 – 15 June (1969 and 1986). For the Bathurst herd, the extent of calving will be the area occupied until 5 July (Figure 12).

Both before and after the peak of calving, movements can be rapid and extensive. From satellite telemetry (1996–98 when the collars transmitted daily), we have measured that the average daily distance travelled changed from 6-10km/day in early June to 2-3/km a day during peak calving (Gunn et al. 2001). By the time the calves are a week old they can be travelling 9-14 km/day as they are aggregating into groups of thousands to 10s of 1000s. Including the movements of caribou cows and their calves up to 3 weeks past the peak of calving increases the size of the area mapped as the extent of annual calving (compared to the area mapped at about the peak of calving). However, at any one time, the cows and calves are only occupying a portion of the calving ground (Table 4, Figure 13). At any 5 day–interval during June 2002, the Bathurst herd occupied a minimum of 5% to a maximum of 58% of the annual calving ground (4% to 77% for the Ahiak herd).

Table 4. Area occupied by satellite collared cows at 5–daily intervals during precalving, peak of calving and 3 weeks post–calving, Nunavut, June 2002.

	Bathurst	**Ahiak**
Date of locations	**Area km^2**	**Area km^2**
4,5 June	2640	2210
9,10	1387	6070
14, 15	385	4847
19, 20	650	3740
24, 25	1370	2972
29, 30	1450	1845
4, 5 July	4812	1157
4 June to 5 July	8317	28 653

Figure 1.2. Area occupied by satellite collared cows of the Bathurst herd at 5-daily intervals during precalving, peak of calving and 3 weeks post-calving, Nunavut, June 2002.

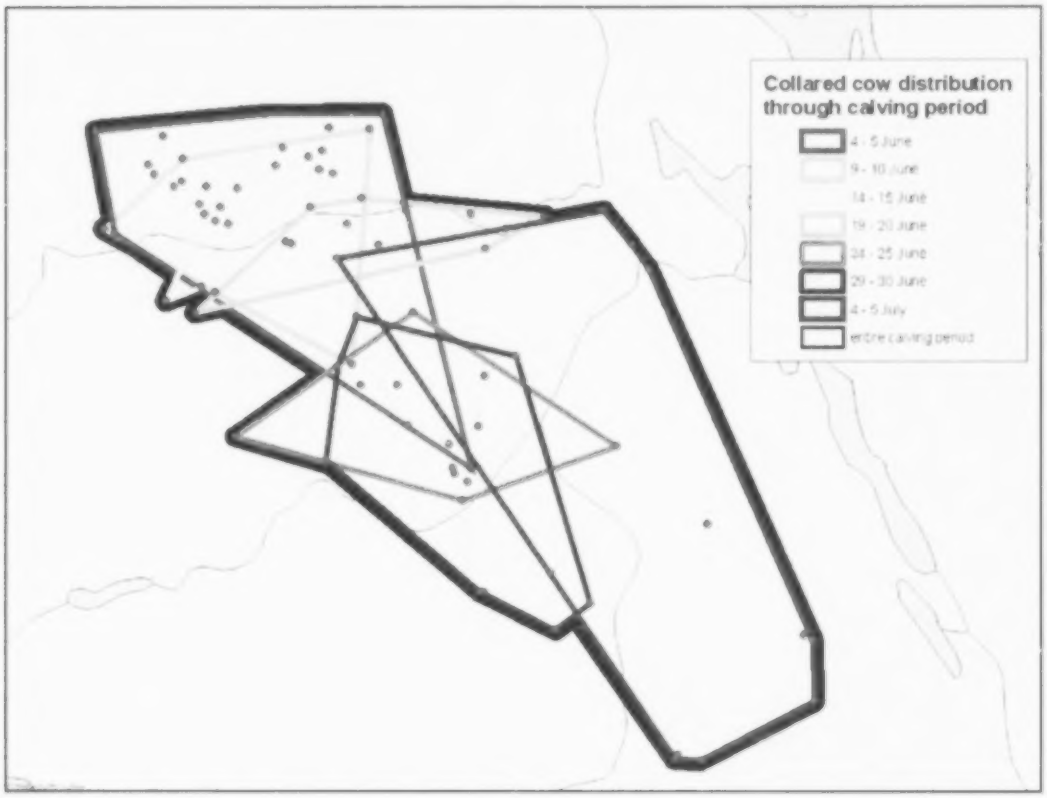
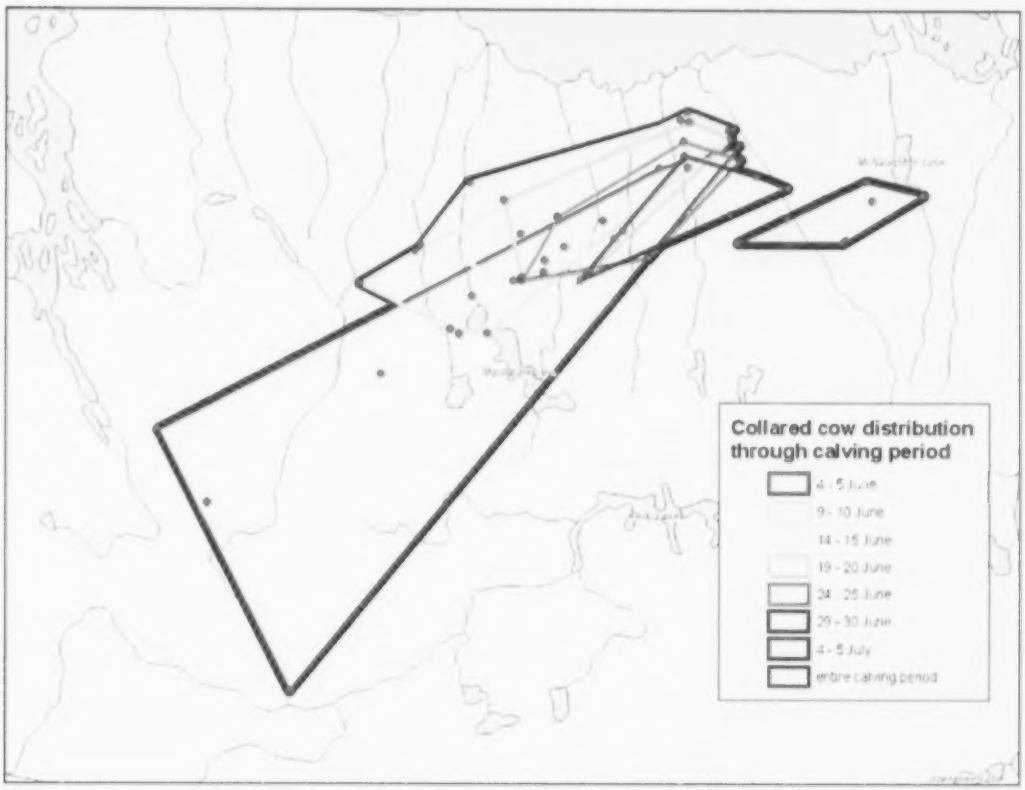


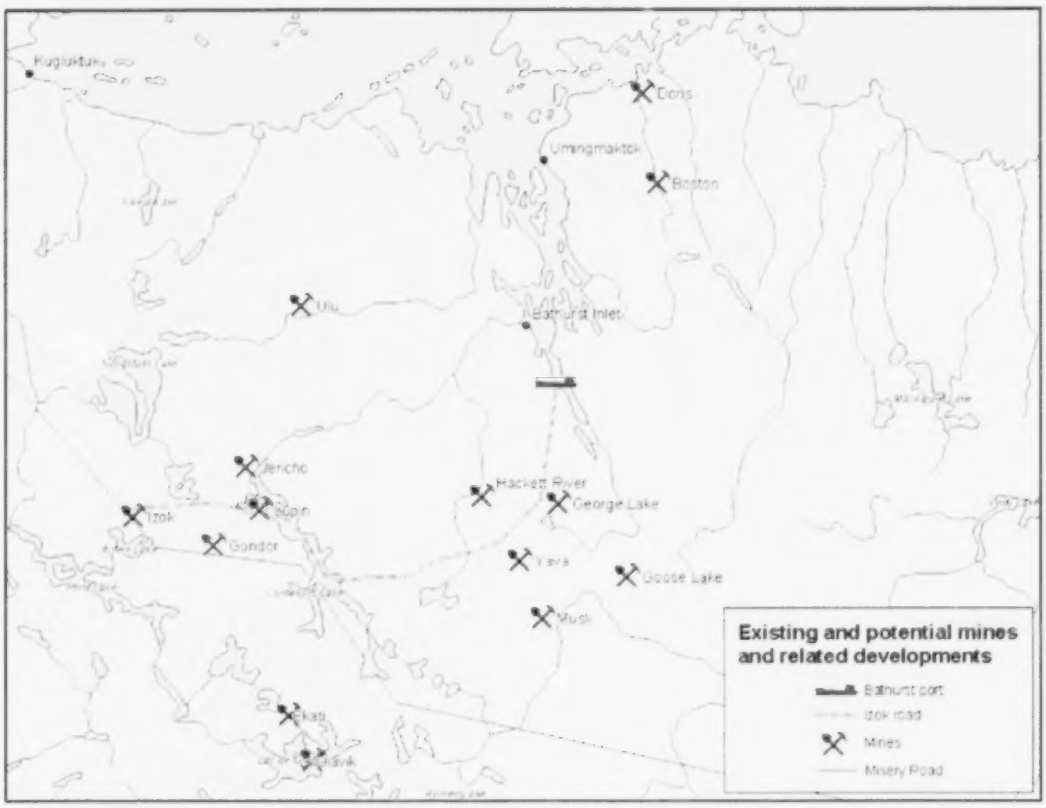
Figure 13. Area occupied by satellite collared cows of the Ahiak herd at 5-daily intervals during precalving, peak of calving and 3 weeks post-calving, Nunavut, June 2002



Satellite-collared cows as representative of the herd's calving distribution.

The extent of calving and movement rates for the Bathurst and Ahiak herds is necessary information for land-use planning given the number of potential mines and associated activities on calving and post-calving ranges (Figure 14). Satellite collared caribou are a useful monitoring tool for land-use planning but are subject to the consideration of how accurately a few collared cows represent the movements of all the cows.

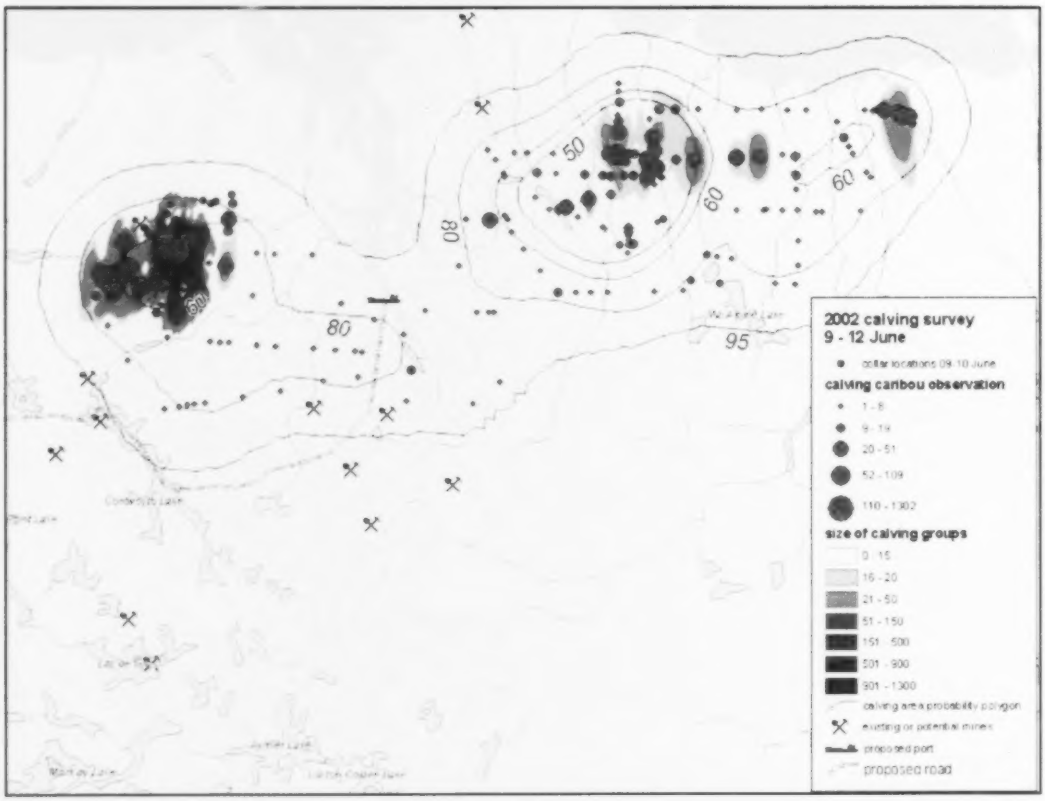
Figure 14. Mining, potential mines and their associated roads in the Bathurst Inlet area, Nunavut 2002.



The satellite-collared cows were within the area occupied by cows with calves for both the Bathurst and Ahiak calving grounds as mapped during the aerial survey 9–12 June 2002 (Figure 15). The only other year when we have aerial mapping and satellite collar locations was in 1996 (Figures 16) when eight satellite collared cows were within the high density calving area defined during systematic reconnaissance surveys on June 9. The ninth satellite-collared cow was within 10 km between the high and moderate density survey stratum. On the Ahiak herd's calving grounds, the

four satellite collars were within the area mapped as extent of calving (Gunn et al. 2000). The comparison of aerial survey and satellite locations for calving argue that the satellite collar locations are representative of where caribou calve. The area enclosing the satellite-collared cow locations is a minimal representation of the extent of calving as the number of collared cows is low (Figures 15 and 16). For example, the area occupied by Bathurst cows with calves was 7 440 km^2 (Figure 7) on 9–12 June 2002 compared to the area occupied by satellite collared cows on 9–10 June 2002 which was 1387 km^2 (Table 4).

Figure 15. The locations of satellite-collared cows from the Bathurst and Ahiak herds relative to the probability of calving at or close to the peak of calving (based on aerial survey data 9–12 June 2002).



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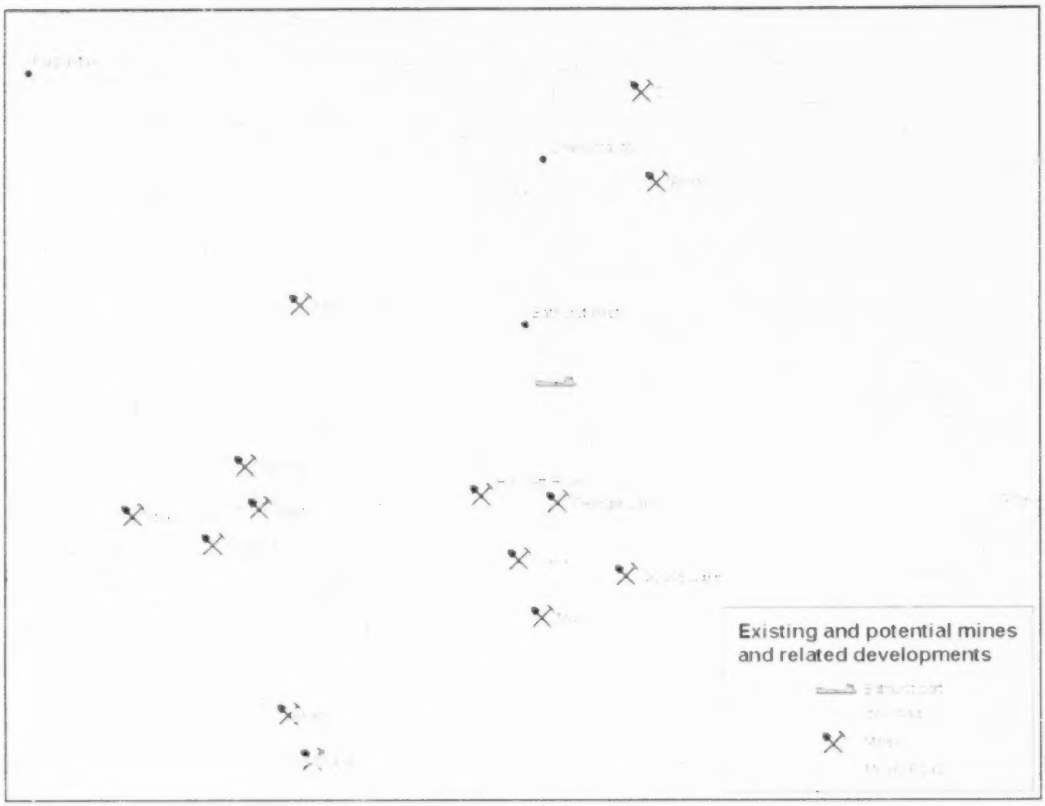

The satellite-collared cows were within the area occupied by cows with calves for both the Bathurst and Ahiak calving grounds as mapped during the aerial survey 9-12 June 2002 (Figure 15). The only other year when we have aerial mapping and satellite collar locations was in 1996 (Figures 16) when eight satellite collared cows were within the high density calving area defined during systematic reconnaissance surveys on June 9. The ninth satellite-collared cow was within 10 km between the high and moderate density survey stratum. On the Ahiak herd's calving grounds, the

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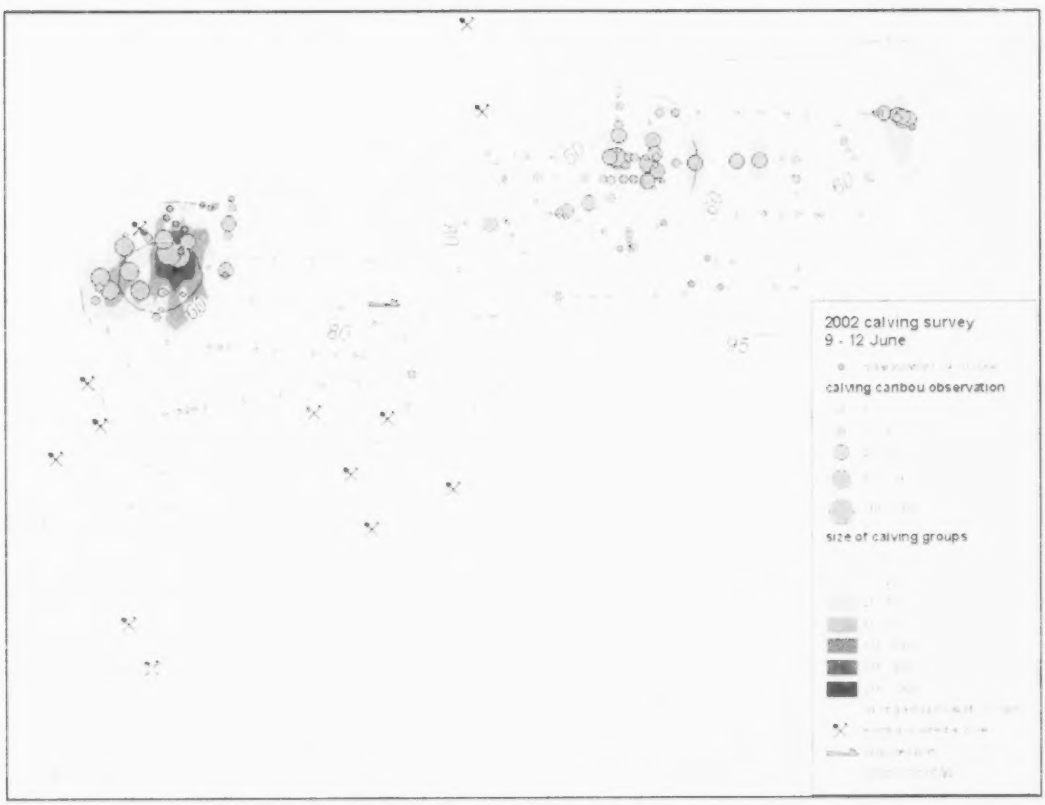
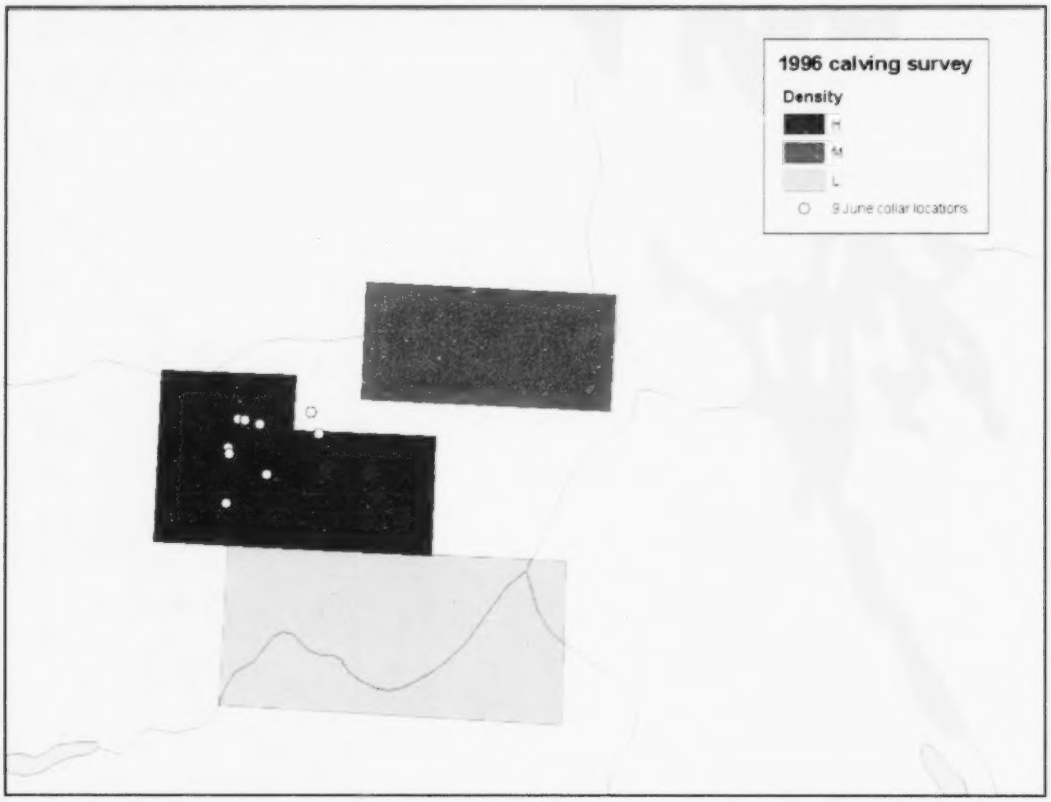


Figure 16. The distribution of satellite–collared cows from the Bathurst herd relative to the high, medium and low density blocks of caribou based on an aerial survey at the peak of calving, June 1996.



Relatively little has been reported about the Ahiak herd but the justification for identifying it as a separate herd from the Bathurst herd (Gunn et al. in prep.) is based on 1996–98 satellite telemetry and that caribou from the Ahiak herd are genetically distinct from both the Beverly and Bathurst herds based on nuclear DNA (K. Zittslau unpubl. data). The 1996–98 satellite telemetry revealed that the Ahiak, Bathurst and Beverly herds overlap on their winter ranges. The Ahiak herd switched from wintering

on the barrens to wintering within the taiga as far south as Rennie Lake in 1997/98 (Gunn et al. 2000), which is the winter range for both the Beverly and Bathurst herds.

We have come some way in understanding how caribou behave on the Bathurst calving grounds through observations by the Inuit (Thorpe et al. 2002, Banci et al. In Press) and research findings (Griffith et al. 2001) and we are making progress understanding some of the reasons why. However, how caribou integrate all of what is happening around them is inevitably complex and in particular, how their individual behavior affects each other remains uncertain. For example, birds gain information about forage availability from watching each other's breeding success (Doligez et al. 2002). Presumably if birds assess and use 'public information', then it seems plausible to expect caribou to be learning from each other. In the meantime, then, we have to accept that caribou calve where they do rather than expect fine–tuned understandings and consequent predictions of where and why caribou calve.

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LITERATURE CITED

Banci, V, C.Hanks, G Atatahak and J. Bolt (ed.). In Press. Draft - Walking in the Path of the Caribou - Knowledge of the Southern Copper Inuit. Kitikmeot Inuit Association. Cambridge Bay, Nunavut.

Doligez, B., E. Danchin and J. Clobert. 2002. Public information and breeding habitat selection in a wild bird population. Science 297:11681170.

Gunn, A. 1984. A review of research on the effects of human activities on barren-ground caribou of the Beverly and Kaminuriak caribou herds, NorthwestTerritories. Northwest Territories Department of Renewable Resources File Report No. 43. 66 pp.

Gunn, A. and F. L. Miller. 1986. Traditional behaviour and fidelity to calving grounds by barren-ground caribou. Rangifer Special Issue No. 1: 151 - 158.

Gunn, A. and M. Sutherland. 1997. Surveys of the Beverly caribou calving grounds, 1957-1994. Northwest Territories Department of Resources, Wildlife and Economic Development. File Rep. No. 120. 119 pp.

Gunn, A., J. Dragon and J. Nishi. 1997. Bathurst calving ground survey 1996. Northwest Territories Department of Resources, Wildlife and Economic Development. File Rep. No. 119. 70 pp.

Gunn, A., B. Fournier and J. Nishi. 2000. Abundance and distribution of the Queen Maud Gulf caribou herd, 1986-98. Northwest Territories Department of Resources, Wildlife and Economic Development. File Rep. No. 126. 76pp.

Gunn, A., J. Dragon and J. Boulanger. 2001. Seasonal movements of satellite collared caribou from the Bathurst herd. Final Report to the West Kitikmeot Slave Study Society, Yellowknife, NWT.80pp. http://www.wkss.nt.ca/HTML/08_ProjectsReports/PDF/SeasonalMovementsFinal.pdf.

Gunn, A., K. Zittslau and B. Patterson. In prep. The Ahiak herd – a recently recognized herd of barren–ground caribou in the Northwest Territories and Nunavut.

Griffith, B, A. Gunn, D. Russell, J. Johnstone, K. Kielland, S. Wolfe,and D. C. Douglas, 2001. Bathurst caribou calving ground studies: Influence of nutrition and human activity on calving ground location. Final report submitted to West Kitikmeot Slave Study Society. Yellowknife, NWT.90pp

Mychasiw, L. 1984. Five-year review of the Beverly and Kaminuriak caribou protection measures. Department of Resources, Wildlife and Economic Development File Report No. 42. 133 pp.

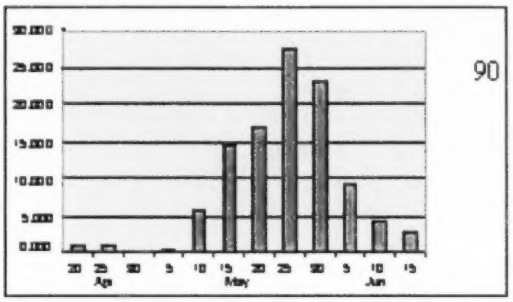
Russell, D. E., G. Kofinas and B. Griffith. 2002. Barren–Ground caribou Calving Ground Workshop: Report of Proceedings. Technical Report Series No. 390. Canadian Wildlife Service, Ottawa, Ontario, 39pp.

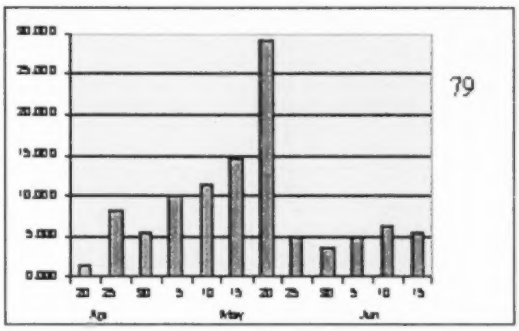
Sutherland, M. and A. Gunn. 1996. Bathurst calving ground surveys, 1965-1996. Northwest Territories Department of Resources, Wildlife and Economic Development File Report No. 118. 97 pp.

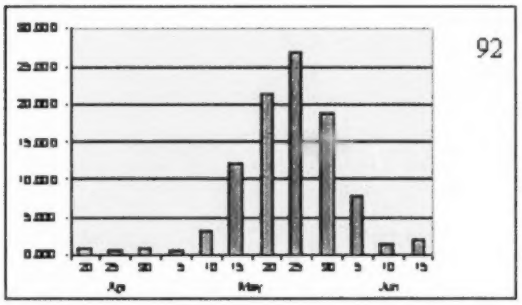
Thorpe. N., N. Hakongak, S. Eyegetok and the Kitikmeot Elders. 2001. Thunder on the tundra Inuit Qaujimajatuqangit of the Bathurst Caribou. Tuktu and Nogak Project, Ikaluktuuthak, NU

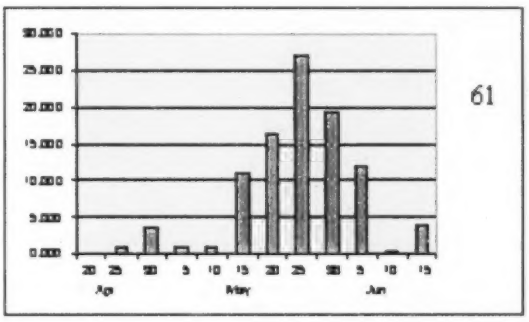
APPENDIX A. Individual distance traveled (km) during spring migration for satellite-collared caribou cows from the Bathurst and Ahiak herds.

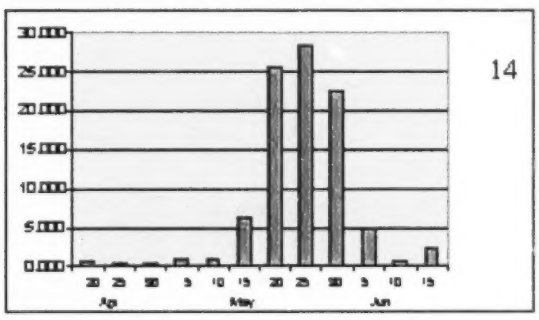
Bathurst Herd

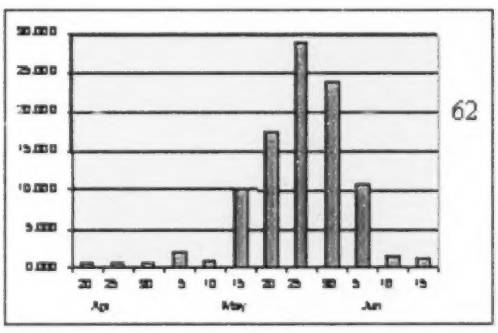


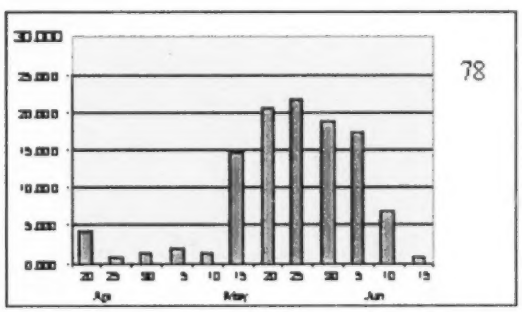


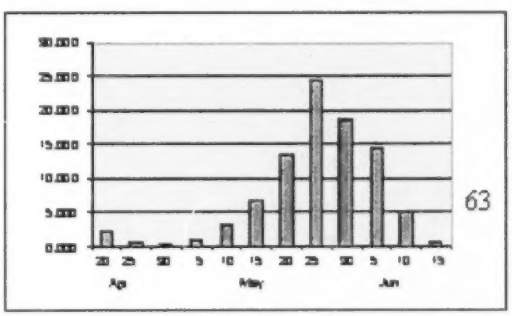






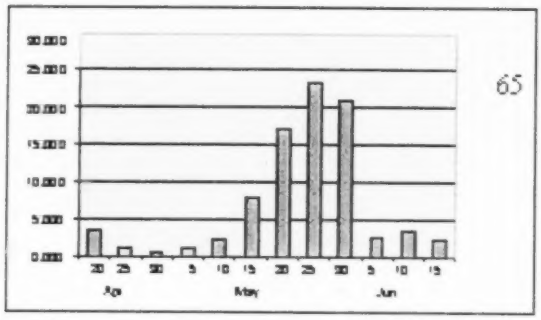


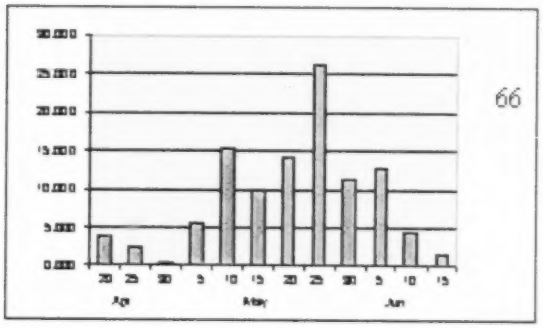


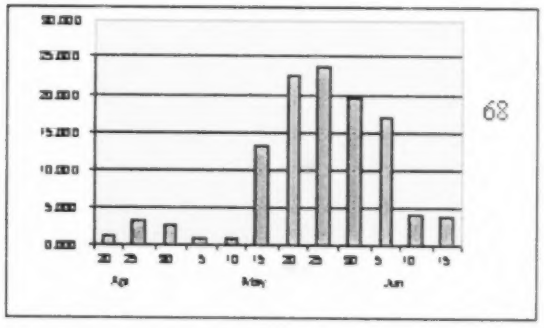


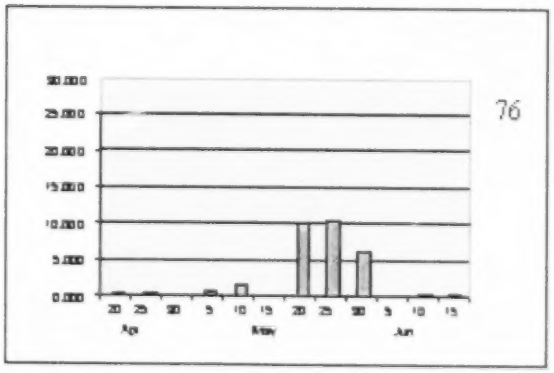
Appendix A. cont'd.

Bathurst Herd



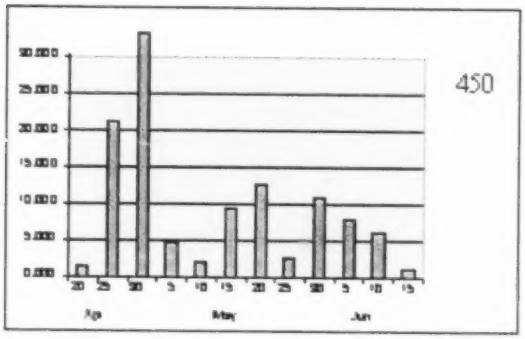


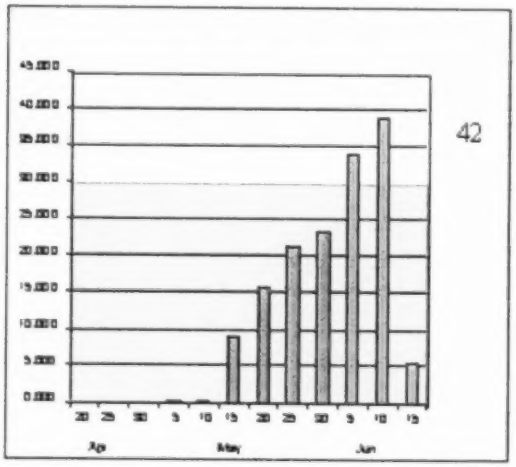


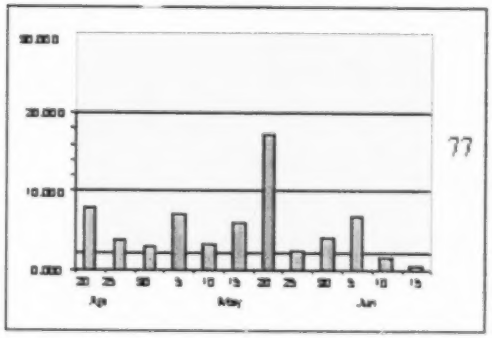


Appendix A. cont'd.

Ahiak Herd 2001







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